**GANYMEDE BRIGHT TERRAIN AT VERY HIGH RESOLUTION: GEOLOGIC STRUCTURE AND REGOLITH PROCESSES.**

R. Aileen Yingst[1], James W. Head[1], Jeffrey M. Moore[2], Clark R. Chapman[3], R. Pappalardo[1], and the Galileo Imaging Team. [1]Dept. Geological Sciences, Brown University, Providence, RI; yingst@pggipl.geo.brown.edu, [2]Space Sciences Division, NASA Ames Research Center, Moffett Field, CA, [3]Southwest Research Institute, Boulder, CO.

**Introduction:** Bright terrain on Ganymede is characterized by sets ("sulci") of relatively high albedo parallel ridges and troughs 100s of meters in vertical relief and 10s of km wide, commonly bounded on either side by large, deep throughgoing grooves [1]. Based on Voyager data, the formation of bright terrain has been plausibly attributed to the emplacement of water ice volcanics [e.g. 2], followed by tectonic extension [e.g. 3]. Recent data returned from the Galileo spacecraft have provided the basis for an updated interpretation of these results [4]. In addition, the return by Galileo of very high (11 m/pxl) resolution images of a region of bright terrain has allowed the examination and analysis of features as small as boulders, yielding a very local perspective of bright terrain characteristics. Using these images, we have classified several geological units within this unnamed sulcus, and have analyzed the various degradation states of these units in terms of local-scale processes. In this way, a picture of local geological processes in Ganymede bright terrain has begun to emerge.

**Approach**: The four high resolution images of an unnamed sulcus (proposed name: Xibalba Sulcus) were targeted based on Voyager images to a location at approximately 30° N, 90°W, within an area of bright terrain [4]. These 11 m/pxl images together display a region of the unnamed sulcus approximately 9 km x 35 km; the easternmost image is shown in Figure 1. Although unexpectedly high scene contrast across the region resulted in some bleeding of saturated portions of the CCD image, a range of significant features are clearly discernible. Craters with diameters down to 10s of meters have been identified, and it is apparent that the comparative scarcity of craters compared with extrapolations of crater counts to small sizes may be attributed either to a shallow sloped production function or a young surface [5]. Contextual comparison of the features in these images with those in the 74 m/pxl Galileo images of Uruk Sulcus (displayed in Figure 2) suggest that the local-scale plains of the unnamed sulcus may be similar in texture to a relatively smooth region of the Galileo G1 Uruk Sulcus high resolution images. The "En Echelon Ridge Terrain" in this Uruk Sulcus image is suggestive of the morphology of the hill clusters in the study area. Confirmation of the nature of the bright terrain in which these high resolution images lie await ~800 m/pxl contextual images returned from the C9 orbit of Galileo.

**Classification and Analysis:** The surface of the unnamed sulcus may be divided into three main types of units: craters, local-scale plains and hills. Units are classified in terms of probable degradation state and stratigraphy. Each unit shows important variations or subsets that are discussed below.

***Craters***: Identifiable craters range in size from below resolution to 1.5 km in diameter. Circular depressions are also observed. These are candidates for the largest craters, and may be up to 5 km in diameter. Three states of degradation are observed. Relatively fresh craters display either a sharp rim or a bright annulus. More degraded craters show only a partial annulus or rim, as well as infilling material in some cases. Highly degraded craters show no evidence of a rim, and instead display a continuous slope from the surrounding topography to the crater floor. On bodies such as Earth's Moon, crater rims are the last part of a crater to erode; at this scale, crater rims in this region of Ganymede appear to be most susceptible to degradation. This, combined with the very low density of small impact craters, suggests that a process other than subsequent impact gardening is at work. In addition, many of the craters examined have parallel lineaments running through the crater floor; these are most easily observed along the N and S rims, where the crater rim appears to be preferentially eroded or degraded. The trend of these lineaments is the same as that of the hills that dominate the landscape, suggesting that a similar process is responsible for formation. Because the N and S portions of crater rims appear to be more susceptible to erosion, rims may appear as parallel elongate hills or boulders. It is thus difficult to discriminate between the smallest craters and areas that may be strewn with boulders on the order of 10s of meters in size.

***Local-scale plains***: Local-scale plains comprise the greatest amount of surface area in the high resolution images. The most prevalent type of plains ("Goosebump Plains") is characterized by a low relief, hummocky appearance, with individual hummocks 10s of meters across. Many of these hummocks are likely small crater rims, as stated above. Others may be clusters of boulders. These clusters are not associated with large craters, as would be expected if they had an impact ejecta origin. Instead, some clusters appear to be associated with the bases of the larger hills, suggesting deposition by down-slope movement. Goosebump Plains appear to lie stratigraphically below smoother-textured plains. These smoother plains have a relatively even brightness and smooth morphology. They occur most frequently at the bases of hills, again suggesting that down-slope slumping or mass wasting of the hills may have occurred. No flow fronts or kipuka-like domes that would denote volcanic flows or mantling are observed. Finally, there appears to be a gradation from smooth plains regions to “Inter-Hill Plains,” a subunit characterized by more densely-packed hummocks 100s of meters across.

***Hills***: The local-scale plains are interrupted by hills and hill complexes 100s of meters across, occurring singly or in large, overlapping clusters. These massifs tend to trend N-S, or SW-NE in the case of the westernmost image. This is the same trend observed in crater lineaments, and may be suggestive of tectonic extension believed to have been prevalent within bright terrain [6]. These hill trends, and the crater lineaments mentioned above, may be a local-scale manifestation of the texture of the ridge and trough complex unique to bright terrain. In some cases, hills appear to be deformed, having a similar base width to single hills but displaying a more subdued slope. This type of hill tends to occur in smooth plains units. In addition, the hillsides have a similar texture to that of smooth plains, suggesting that the process responsible for hill deformation is common to both units. Portions of the hills in shadow but illuminated by back-reflected Ganymede light show evidence for textures suggesting downslope movement to the base of slopes (see image at http.//www.jpl.nasa.gov/galileo/sepo/atjup/ganymede/G1unsul.html. Because of the similarities to smooth local-scale plains, the current best candidate for this process is mass wasting.

**Conclusions:** No overt evidence for cryovolcanic activity, such as vents or flow fronts, has been observed for this region of bright terrain imaged at 11 m/pxl. This suggests that, while cryovolcanism may have played a role in the initial emplacement of the higher albedo ice, it has not been recently dominant at this scale at this location. Lineaments within craters and hill trends suggest the formation of this type of terrain due to tectonic extension, a process that may be visible even at this scale. Finally, the morphology of many of these features suggests the modification of these units by some process such as mass wasting around the massifs, and possibly local-scale sublimation within smoother terrain to produce a local concentration of blocky, rough material [7].

**References:** [1] S. Squyres, *Icarus 46*, 156, 1981. [2] M.E. Allison and S.M. Clifford, *JGR 92*, 7865, 1987. [3] M. Golombek and M. Allison, *GRL 8*, 1139, 1981. [4] J. Moore, *et al.*, *Proc. GSA 28*, A-71, 1996. [5] C. Chapman and W. Merline, *Bull. AAS 28*, 1139, 1996. [6] R. Pappalardo et al., *Proc GSA 28*, A-70, 1996. [7] J. Moore *et al.*, *Icarus 122*, 63, 1996.

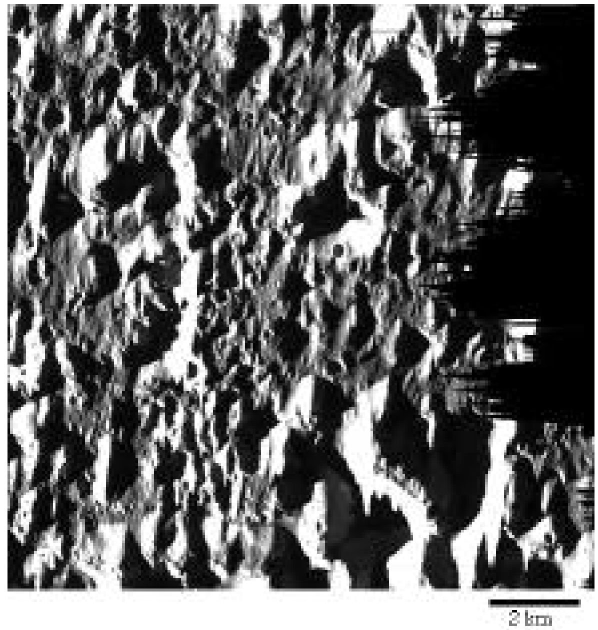


Figure 1. Easternmost region of study area Galileo image. 11 m/pxl resolution

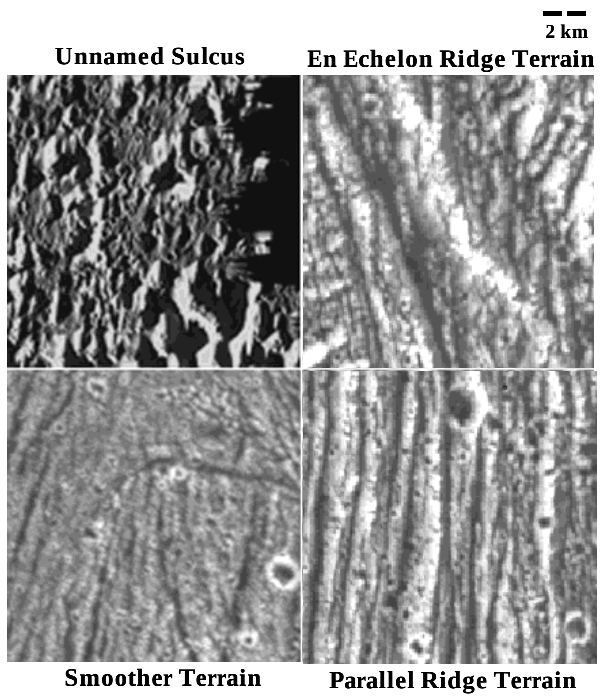


Figure 2. Comparison of bright terrain morphology. All images are at the same resolution ~74 m/pxl and scale.